Report

Draft Building-Specific Evaluation of Indoor Air and Mitigation Measures RES234/235/236

Ex. 6 Personal Privacy (PP)

Triple Site Offsite Operable Unit Sunnyvale, California

Date Published: ~~25 February~~31 March 2022

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
1,1,1-TCA	1,1,1-trichloroethane
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
AMD	Advanced Micro Devices
BSER	Building-Specific Evaluation of Indoor Air and Mitigation Measures Report
cis-1,2-DCE	cis-1,2-dichloroethene
COC	Chain of Custody
DTSC	Department of Toxic Substances Control
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
HVAC	Heating, Ventilation and Air Conditioning
Locus	Locus Technologies
OOU	Offsite Operable Unit
PCE	tetrachloroethene
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RPD	Relative Percent Difference
SMDS	Sub-Membrane Depressurization System
SSDS	Sub-Slab Depressurization System
TCE	trichloroethene (trichloroethylene)
trans-1,2-DCE	trans-1,2-dichloroethene
VOCs	Volatile Organic Compounds

1. Introduction

The RES234/235/236 property at Ex. 6 Personal Privacy (PP) Court is located within the Environmental Protection Agency (EPA) Triple Site Offsite Operable Unit (OOU) Superfund Site (http://epa.gov/superfund/TripleSite). The Triple Site was established to clean up groundwater containing volatile organic compounds (VOCs) such as trichloroethylene (TCE). TCE is used in various industries and products such as a degreaser, and as an ingredient in glues, paint removers, spot removers, and some cleaners. TCE can cause harmful health effects if present at high enough levels. Historically, about 0.5 miles away TCE was used at the former Signetics, Advanced Micro Devices Inc. (AMD), and TRW Microwave sites (collectively referred to as the Triple Site) to fabricate silicon chips. The electronics manufacturing operations stopped in the 1960s-1980s, and the parties responsible for the environmental cleanup have been conducting activities to contain and clean up TCE in the shallow groundwater. This cleanup process continues today and will be ongoing for many more years. Based on results from testing done at homes in the San Miguel neighborhood, TCE in groundwater is volatilizing and has migrated into some neighborhood homes through a process called vapor intrusion.

This Building-Specific Evaluation of Indoor Air and Mitigation Measures Report (BSER) was prepared by Locus Technologies in accordance with the Indoor Air / Vapor Intrusion Sampling and Analysis Removal Work Plan for the Triple Site Offsite Operable Unit in Sunnyvale, California (Vapor Intrusion Work Plan) (Locus, 2020; https://semspub.epa.gov/src/document/09/100024154). The Vapor Intrusion Work Plan was prepared in response to the 2019 Administrative Settlement Agreement and Order on Consent between the ~~United States Environmental Protection Agency (~~EPA~~)~~ and Philips Semiconductors, Inc. (Philips) for Evaluation of Vapor Intrusion to Indoor Air and Conditional Evaluation and Implementation of Mitigation Measures for the Triple Site Offsite Operable Unit ~~(OOU)~~ (EPA,

2019; https://semspub.epa.gov/src/document/09/100018488). The settlement was entered into voluntarily by Philips, ~~Advanced Micro Devices~~AMD, ~~Inc. (AMD)~~, Northrop Grumman Systems Corporation, and the EPA with an effective date of 22 September 2019.

1.1 Purpose

This Draft BSER provides the current status of activities (Section 4) and findings (Section 6) of the vapor intrusion investigation for the subject property. Indoor air sampling results do not meet EPA's health-protective screening values. A vapor intrusion mitigation system is proposed as described in Section 7.

This BSER was prepared as prescribed in the Flow Chart for Implementation of the site-wide Vapor Intrusion Work Plan (Work Plan Flow Chart, Figure 5 of the Vapor Intrusion Work Plan), which is designed for the evaluation of individual properties identified for vapor intrusion investigation. The Work Plan Flow Chart identifies action items, deliverables, and communications in a coordinated process flow.

BSERs are developed progressively throughout the investigation of the property. Draft (interim) BSERs are acknowledged to be incomplete with respect to the eventual Final BSER that will be prepared for this building at the end of the investigation. This BSER is designed to be updated as the investigation proceeds for the building. *Any BSER that has been received by an owner or tenant of the subject property is a BSER that has been reviewed and approved by EPA.*

Draft BSERs will be prepared at various stages of the investigation to provide the opportunity for EPA to review sampling results, investigation findings, and any planned response actions (additional sampling, mitigation, etc). Draft BSERs are prepared, as applicable, at the following stages of the vapor intrusion investigation, in accordance with the Work Plan Flow Chart:

- After sampling events conducted for the purpose of investigating the potential for vapor intrusion, after receipt of laboratory analytical results.
- If sampling results trigger a recommendation for mitigation. See Section 1.2 for more information.
- If a vapor intrusion mitigation system is newly installed.

The Final BSER for a building is prepared at the conclusion of the vapor intrusion investigation, for example:

- Indoor air sampling that includes at least two winter heating season sampling events is completed, and the results show no unacceptable risk to human health due to vapor intrusion and no further action at the property is warranted.

1.2 TCE Action Levels and the Decision Framework for Mitigation System Installation

Trichloroethene (TCE) belongs to a chemical category called volatile organic compounds, which are used in degreasers, paint removers, adhesives, and manufacturing. Vapor intrusion is a process where vapors from historic releases to groundwater may migrate inside buildings. Drinking water at the property does not come from groundwater.

The EPA sets forth screening levels and action levels for concentrations of trichloroethene (TCE) in ambient indoor air. The following is a summary of TCE screening and action levels that drive the vapor intrusion investigation and the mitigation systems that may be warranted. Detailed information on vapor intrusion mitigation systems and the Decision Framework for their installation are in the Vapor Intrusion Work Plan.

The **Accelerated Response** Action Level for TCE, is defined as a detection of TCE in ambient air samples at concentrations greater than 2 micrograms per cubic meter ($\mu g/m^3$). For a confirmed vapor intrusion occurrence of TCE above this level, responsive action will be taken within a few

weeks to reduce TCE in the air. For a confirmed vapor intrusion occurrence of TCE above the **Urgent Response** Action Level, defined at 6 µg/m³, a responsive action will be taken within a few days to reduce TCE in the air. Interim measures may be implemented first while options for sustained mitigation measures are considered.

Possible interim measures to quickly reduce the TCE levels of indoor air may include increased ventilation or using an air purifier with an activated carbon filter. Sustained mitigation measures may include a sub-membrane depressurization system (SMDS) or sub-slab depressurization system (SSDS). SMDS and SSDS vapor intrusion mitigation systems are designed to draw air from underneath a residence and route that air to a plastic vent stack (riser pipe). The system prevents the entrance of underground vapors into the building. The vent stack transfers these vapors directly to the outdoor air where they immediately dilute and are broken down by sunlight. Vapor intrusion mitigation systems may be active (using a powered fan) or passive (using convection) to move air up the stack and into outdoor air.

EPA's TCE health risk Screening Level of 0.48 µg/m³ is set at a concentration that is not expected to pose a significant cancer risk from long-term exposure (26-years) over a lifetime incorporating a margin of safety. Indoor air TCE between 0.48 and 2 µg/m³ is still within the acceptable health risk management decision range. These are concentration levels that are reasonably protective of human health over a lifetime. If indoor air sampling confirms a result within the health risk management decision range, a weight-of-evidence approach will be used to determine if a vapor intrusion mitigation system is recommended (refer to Section 6.5.3 of the Vapor Intrusion Work Plan [Locus Technologies, 2020]). Available data, including TCE concentrations in groundwater beneath the building, will guide the decision. Furthermore, if no indoor air data is available from the property, information from neighboring properties and other factors will be considered to determine if a mitigation system is warranted.

Ultimately, additional post-removal site controls may be needed for properties within the Triple Site Offsite Operable Unit. Additional post-removal site controls may include:

- Recorded agreements and/or tracking system to help provide notice to current and future owners, occupants, and EPA and Locus when there is a change in building ownership or configuration.
- Recorded agreements providing EPA and Locus the necessary access to maintain, operate, and remove, when appropriate, the vapor intrusion mitigation system.
- Mapping or tracking system to help ensure that stakeholders are informed of the appropriate construction specifications and the need for consultation with EPA when making inquiries with the City of Sunnyvale regarding the property.

A plan for post-removal site controls will be prepared upon EPA approval of other BSERs at properties throughout the neighborhood.

1.3 Project Team Contacts

The Project Team consists of the following main personnel:

Role	Name	Contact
EPA Project Manager	Michael Schulman	(415) 972-3064 Schulman.Michael@epa.gov
Project Coordinator & Community Involvement Coordinator	J. Wesley Hawthorne	(415) 799-9937 hawthornej@locustec.com
Project Technical Lead	Nancy-Jeanne LeFevre	(650) 450-8286 lefevren@locustec.com

Manager of Environmental Services	Africa Espina	(415) 799-9821 guzuna@locustec.com
Field Coordinator	Alan Tuan	(408) 781-2150 tuana@locustec.com

In case of any questions or concerns regarding an installed vapor intrusion mitigation system at the subject property, please call Locus Technologies at 408-329-6654 at any time to speak to a vapor intrusion mitigation system representative.

2. Building/Property Identification

The subject property is located at Ex. 6 Personal Privacy (PP) in Sunnyvale, CA, and entails a two-story apartment complex with approximately 3,000 square feet. There are three ground-floor units, each containing roughly 1,000 square feet. To protect personally identifying information, the subject property was assigned the Residence Numbers RES234 (Unit #1), RES235 (Unit #3), and RES236 (Unit #2).

The building has an earthen crawlspace with passive ventilation (expected to be between 2.5 to 3.5 feet in height; 7,500 to 10,500 cf in volume). A building layout is presented in Figure 1, which also identifies where air samples are collected. Air sample location identifier names in Figure 1 correspond to the "Location ID" in the attached Table 1 presenting the TCE air sampling results.

3. Communications Plan

Property access was established with property owner in advance of air sampling on the subject property. The owner signed the access agreement on 5 December 2021, and the agreement

was fully executed on 6 December 2021. The agreement can be found in an appendix attached to this report. Records of previous communication to property owners are included in Appendix R. If requested by the owner, EPA and/or Locus will discuss with the owner the BSER via a phone call.

~~Although uncommon, in the event that indoor air trichlorethene (TCE) sampling results exceed EPA Urgent Response Action Level of 6 µg/m³ (Section 1.2), the owner would be notified via phone and/or email of sampling results and the proposed next steps. If applicable, residents will also be notified.~~

As specified in Section 1.1, an updated BSER draft will be provided to the owner upon recommendation of mitigation, after the mitigation system is installed, and upon completion of the vapor intrusion investigation. Additionally, air sampling results will be communicated via mail, e-mail, or phone to ~~via email and/or phone if:~~

~~1. Indoor air results exceed the Accelerated Response Action Level of 2 µg/m³ TCE.~~

~~Owner/s, tenant/s, or owner's representatives inquire of sampling results.~~tenants, with owner and/or property management approval.

Although uncommon, in the event that indoor air trichlorethene (TCE) sampling results exceed EPA Urgent Response Action Level of 6 µg/m³ and/or EPA Accelerated Response Action Level of 2 µg/m³ (Section 1.2), the owner would be notified via phone and/or email of sampling results and the proposed next steps. If applicable, residents will also be notified.

The owner of this property is:

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Road, Los Altos Hills, California 94022

The owner has indicated the following primary contact for this property:

- CedarBrook Corp, Kathy Hughes, 408-735-9584, cedarbrook.corp@gmail.com

The primary contact has indicated the following preferences for communication:

- Phone
- E-mail
- The primary contact will then reach out to tenants

The primary contact will be notified in instances that arise following any, if applicable, building walkthroughs or vapor intrusion mitigation system operations and maintenance inspections. Relevant feedback might include findings of leaking pipes, or other information that would be pertinent to the owner's maintenance of the property. If property owners or residents have any questions regarding this BSER or mitigation plans, Locus Technologies may be contacted using the Project Team Contacts table in Section 1.3.

4. Chronology of Vapor Intrusion Investigation

The following summary provides a timeline of events at the subject property:

Date	Activity	Notable Findings	
5 December 2021	Property Access Agreement Executed by Owner (Appendix A)		Letters from EPA to Owner Dated 11/19/2021

[1] Letters were sent to the owners and, where applicable, tenants; however, only the letters sent to the owners are referenced and included in Appendix R.

Date	Activity	Notable Findings	
16 December 2021	Building Survey and Sampling Event (Appendix D and Table 1)	Sampling Results did not meet EPA's health-protective screening values (TCE above EPA's Accelerated Response Action Level under a kitchen sink).	
5 January 2022	Building Survey and Sampling Event (Appendix D and Table 1)	Sampling Results did not meet EPA's health-protective screening values (TCE above EPA's Accelerated Response Action Level under a kitchen sink).	
19 January 2022	Accelerated Response to Sampling Results	Air Purifiers were provided for RES234, RES235, and RES236 as an interim mitigation measure to ensure the indoor air remains health-protective while planning for a mitigation system for the building	
~~25 February~~31 March 2022	Draft BSER	Mitigation proposed; Provided to EPA	

5. Data Evaluation

Table 1 presents TCE air sample laboratory analytical data collected to date that was used for the evaluation of potential TCE vapor intrusion to human health-based action levels and to confirm that the vapor intrusion mitigation system is operating properly.

Sections 5.1 through 5.3 below provide an explanation of any data results collected from the subject property that were excluded. Data results may be excluded due to field or laboratory quality issues or due to the detection of TCE from potential indoor or outdoor sources that is not related to vapor intrusion. Table 2 presents all sampling data related to the subject property and related outdoor air samples collected as a part of the vapor intrusion investigation.

5.1 Quality Assurance/Quality Control Results and Usability

Quality assurance/quality control (QA/QC) samples were collected to determine the accuracy of field and laboratory procedures during sampling activities in accordance with the Quality Assurance Project Plan (QAPP), Appendix C of the Vapor Intrusion Work Plan. QA/QC of samples collected by EPA was completed by EPA as a separate effort; however, if EPA found any of the data to be unusable, those findings are discussed herein.

As noted in the associated laboratory report in Appendix Q, the sample location RES235-PATH-2 on 16 December 2021 was located on the ledge of the passive crawlspace vent instead of entirely within the crawlspace. Ultimately, the sample location was identified as not a true outdoor air (OUT) sample nor a true vapor intrusion pathway (PATH) sample. Therefore, the sample was excluded from the analytical laboratory report and the Location ID was retired. Notably, the laboratory report misstates the timing of the request for exclusion of the sample; the request for sample exclusion was issued prior to issuance of the analytical data report.

5.1.1 Field QC Samples

Field QC duplicates and field blanks samples were collected to assess the potential for contamination associated with field sampling equipment, containers, and procedures.

5.1.1.1 Duplicates

Duplicate samples were collected to determine if two side-by-side samples have the same result within acceptable limits. Sample results are considered to be comparable if the relative percent difference (RPD) of the field duplicate and the primary sample are within 25% of each other. No duplicate RPDs exceeded acceptable limits at the subject property.

5.1.1.2 Field Blanks

Field blanks of known clean samples were evaluated to determine if any analytes (such as TCE) were introduced travelling to and from the laboratory. There were no detections in any field blanks associated with sampling at the subject property.

5.1.2 Laboratory QA/QC Samples

Laboratory QA/QC samples were prepared and analyzed to determine whether laboratory procedures were followed during routine operations.

5.1.2.1 Method Blanks

Clean method blanks were analyzed to determine if any analytes (such as TCE) were improperly detected. No compounds were detected in any method blanks associated with analytical data for the subject properties.

5.1.2.2 Surrogates and Laboratory Control Spike/Laboratory Control Spike Duplicates

Percent recovery of surrogates and laboratory control spike/laboratory control spike duplicates (LCS/LCSD) was evaluated against the limits of 70-130%. No LCS or LCSD recovery exceeded acceptable limits at the subject property.

Relative percent difference (RPD) of LCS/LCSDs was evaluated against the limit of 20% RPD for sampling by EPA Method TO-17. The RPDs of all LCS/LCSDs were within limits.

5.2 Results with Background Outdoor Air Interferences

Since 2015, background outdoor air TCE concentrations from the surrounding neighborhood north of Duane Avenue have ranged from not detected up to 1.6 µg/m^3. TCE in background outdoor air are from unknown sources and not expected to be from TCE in groundwater and vapor intrusion. The background outdoor air sample results associated with this property are shown as "OUT" samples in Tables 1 and 2.

As shown in Table 1, during both sampling events, TCE concentrations in the outdoor air were below detection limits. Therefore, background outdoor air did not interfere with the indoor air vapor intrusion evaluation.

5.3 Results with Indoor Source Interferences

Trichloroethene (TCE) is used in some household products such as wood finishes, adhesives, paint removers, and stain removers. The TCE in these products may evaporate into the air and can result in detections during indoor air sampling. Locus conducts building surveys prior to sample placement and attempts to identify and isolate these products. Additionally, tetrachloroethene (PCE) and TCE are chemicals commonly used in dry cleaning, although use of these chemicals are currently being phased out in California, and will be completely phased out by 2023. PCE is not known to be a potential concern for vapor intrusion at the project site, so the detection of both PCE and TCE during air sampling can indicate indoor source interferences unrelated to vapor intrusion. Interviews are conducted along with building surveys

with residents to determine potential construction, dry cleaning, hobbies, and activities that may contribute indoor air interferences with respect to vapor intrusion evaluation.

As shown in Table 2, PCE concentrations were below detection limits at the subject property; therefore, potential indoor sources did not interfere with the indoor air vapor intrusion evaluation.

6. Building Sampling Results and Recommendations

The indoor air results meet EPA's Urgent Response Action Level (6 µg/m^3) but do not meet EPA's Accelerated Response Screening Level (2 µg/m^3) for TCE and indicate unacceptable vapor intrusion. Therefore, a vapor intrusion mitigation system is recommended for installation at the subject property and is described in Section 7. Air purifiers were provided to all ground floor units (RES234, RES235, and RES236) on 19 January 2022 as an interim mitigation measure to ensure the indoor air remains health-protective while planning for a mitigation system for the building.

7. Mitigation Plan

Locus recommends the installation of an active TCE vapor intrusion mitigation system called a sub-membrane depressurization system (SMDS) for this property to prevent the entrance of underground TCE vapors into the building. As introduced in Section 1.2, these vapor intrusion mitigation systems are designed to draw air from underneath a residence and route that air to a plastic vent stack (riser pipe). Active vapor intrusion mitigation systems use a powered fan to generate suction. The vent stack transfers ~~these ground~~ vapors directly to the outdoor air where they immediately dilute and are broken down by sunlight.

7.1 SMDS Vapor Intrusion Mitigation Plan

7.1.1 SMDS Description

The SMDS will entail laying evenly spaced perforated pipe (3 or 4 inches in diameter and not less than 10 feet in length) on the floor of the crawlspace. Alternatively, a Soil Gas Collector (SGC; 1 inch in height) will be routed around the perimeter of the foundation, with branches of SGC extending into smaller areas; all openings in fabric joints, "tees," and ends of branches will be taped. A 12-mil high density, cross-laminated polyethylene vapor barrier will then be laid over the perforated pipe or SGC. The vapor barrier will be sealed at all seams with caulk followed by tape and to the exterior footing with caulk and mechanical fasteners. The vapor barrier will overlap at least twelve inches at seams. VOCs in sealing materials will be minimized. Ultimately, perforated pipe (or the SGC) will have a collection point that connects to a single suction fan located on the exterior of the building. It is suspected that the crawlspace area is connected beneath the building; if this is not the case, the collection point may entail an exterior connection between perforated pipe (or the SGC) under isolated sections of the crawlspace. Locus will install and maintain the system. Reimbursement of electricity costs for fan operation is available and will be discussed with the property owner.

The suction fan will be covered with a shroud for aesthetic purposes and will exhaust at least one foot above the roofline via a vent stack alongside the exterior of the residence. Fan operation is very quiet and is not expected to be an issue; however, a sound muffler will be provided if requested by the owner or occupant. A screen/mesh not larger than ½ inch (and not smaller than ¼ inch) will cover the opening of the vent stack. Air velocity, flow, and vacuum measurements will be collected at the suction pipe upon initial installation to ensure the SMDS is providing a negative pressure under the membrane.

A remote communication system will be installed at the site to communicate with Locus directly whenever the fan operation fails, that is, when the vacuum falls below 0.25 inches of water (WC). A local alarm will not be installed unless requested by the owner. A posted placard near the remote dialer will include instructions and contact information for the occupants to call Locus' mitigation services for any questions or concerns. Depending on the furnace configuration at the property, a carbon monoxide detector may be appropriate for the indoor space, and will be provided to the property owner if warranted.

Locus can install a system-dedicated magnehelic manometer on the suction pipe to continuously display the vacuum of the depressurization system. However, Locus is not expecting owner(s) or occupant(s) to assume operational responsibility. Additionally, although the remote dialer does not display the vacuum, Locus is automatically notified of operational failure based on measured system vacuum (and power outage). If the owner(s) or occupant(s) would still prefer the magnehelic manometer add-on, it can be located at the location of the suction pipe or indoors. Installation of the magnehelic manometer indoors will entail running additional conduit for the vacuum tubing from the suction pipe to the magnehelic manometer.

The system will be installed in accordance with ASTM E2121-13, Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings. Installation is expected to take 1 to 3 days depending on the specific site conditions. The occupants are expected to be able to maintain normal activities throughout the installation process.

After implementation, air sampling will be conducted (refer to Section 10) in order to ensure mitigation effectiveness. The mitigation will be determined to be effective if air sample results in the occupiable space are at or below the EPA long-term screening level (0.48 µg/m^3) under normal occupancy conditions. Previous sample results from the occupiable space have shown concentrations ranging from 1 to 1.6 µg/m^3. Therefore, a concentration reduction of 70% or

more in the occupiable space would be considered effective. If concentrations are consistently observed above 0.48 µg/m^3 in the crawlspace, and there is a statistically significant difference between the indoor concentrations and the ambient background concentrations, Locus will conduct additional evaluation to determine if further actions are warranted.

7.1.2 SMDS Specifications

A generic system diagram can be found in Appendix E. The mitigation installer is licensed by the California State License Board and is certified and listed by the National Radon Safety Board for radon mitigation. The mitigation installer will therefore inspect the home and installation process for potential adverse effects. If any are identified they will be brought to Locus' attention to determine whether there exist feasible options to control for adverse effects, including if a Warm-Air Heating, Ventilating, and Air-Conditioning professional is needed to inspect the system or conduct work. Additionally, any constraints on this design identified by the mitigation installer during a walk-through will be brought to the attention of EPA for approval of any necessary changes prior to installation.

Specifications for the following system components are as follows (details for which can be found in Appendix F, if applicable):

- Model RP145 mitigation fan by RadonAway (or equivalent fan). Alternatives include Model RP260 or SF180, if necessary. Fans are expected to operate at 0.5" WC static vacuum.
- Model 12WB Dura-Skrim membrane by Raven Engineered Films.
- Caulk for membrane seals: Liquid Nails Product LN-704.
- Tape for membrane seals: Vapor Bond Tape (TVB4) by Raven Engineered Films.
- Fasteners for membrane to foundation walls: Vapor Barrier X-mas Tree Fasteners, RadonAway Part Number 67055.

- Sensaphone Sentinel remote dialer
- Dwyer Series 2000 Magnehelic Manometer, Part # 2001, 0-1.0"WC (available add-on for continuous display of vacuum).
- Vent stack pipe and fittings: 4" schedule 40 PVC (ASTM D-2665 DWV), white.
- Sub-membrane tee fittings, where applicable: Sanitary fittings installed in the direction of air movement to reduce friction losses.
- Tee fittings in manifold piping: Double sanitary tee cleanout fittings when air movement is from opposite directions.
- Vertical pipe runs: Supported at least every 8 feet and at every penetration through floors, ceilings or roof decks.
- Horizontal pipe runs: Supported with code approved hangers every 6 feet and within 2 feet of any fitting.
- PVC pipe connections: Solvent cemented using a clear primer that complies with ASTM F-656 and a PVC cement that complies with ASTM D-2564. Joints will be made while solvent is wet and in accordance with ASTM D-2885 and ASTM F402.
- Fan electricity: Provide a disconnect within 6 feet of the fan for servicing.
- Circuit Breakers: Dedicated, if feasible.
- TSI VelociCalc Plus 8386 or similar: handheld device used to measure the fan's airflow/speed

A gas-tight sampling port (1/4" pipe and sampling nipple with brass ball valve) will be installed above (downstream) of the fan for as needed vapor stack sampling. The port will also be used to measure vacuum. Airflow measurements will be collected from top of stack or using an anemometer that can take measurements at ground-level.

Weather-proof placards will be securely affixed at the fan location and at crawlspace access points and will include the following information:

- Locus contact information
- Notification that the system is to remain on (for example, "Do Not Turn Off") and instructions to call Locus immediately in the event of a system off condition
- Notification of mitigation system components and purpose, for example, "TCE Reduction System" and "Do Not Alter"

EPA will have the opportunity to review final language of placards before posting. Additionally, weather-proof labels will be affixed to system components (for example, membrane, sub-liner ventilation system, fan, vent stack, electric conduit and box, and circuit breaker) using a handheld printer. Routine inspections entail inspection of 'system labeling,' which will ensure that labels are maintained legible and professional.

A licensed electrician was consulted to determine appropriate wire sizes for the fan. Local municipal permits will be pulled, and any inspections will be completed to ensure that all electrical connections installed as part of this mitigation effort meet the City of Sunnyvale requirements.

7.1.3 Implementation Schedule

Within 7 calendar days of EPA and owner approval of this mitigation plan, pre-field mitigation activities will commence.

Within 45 calendar days of completion of mitigation installation (including permits), an updated Draft BSER (Work Plan Flow Chart deliverable "G") will be submitted to EPA including as-built drawings, field logs, and an occupant information sheet. Mitigation activities will be considered complete upon determination by sample results (collected in accordance with the post-installation sampling plan in Section 10.2) that the system is effective.

7.1.4 Justification

Sub-membrane depressurization systems are a proven technology installed throughout the country for residential mitigation of VOCs in indoor air (EPA, 2015). The systems have an even longer record of effectiveness for the purposes of radon mitigation, complete with ASTM standards. The mitigation system will reduce the entry of soil gases into the residence by effectively sealing pathways of vapor intrusion from the crawlspace and providing an active alternate ventilation pathway to the atmosphere. Due to the likelihood of success of this design, disruption to the residents is expected to be minimized and the implementation process is expected to be efficient and expedient.

7.1.5 Potential Alternatives (if necessary)

If the SMDS does not initially meet effectiveness criteria, the potential contributions from indoor air background sources will be evaluated first. If no background sources are identified, the system will be inspected for: good seals (including the membrane itself and membrane seals to penetrations and exterior footing), sufficient fan velocity, and other adjustments to improve effectiveness. If the SMDS still does not meet effectiveness criteria, alternatives will be implemented and tested. Alternatives or add-ons that may be considered include sealing utility pathways, additional perforated piping, and suction fan upgrades.

The mitigation installer will make all efforts to install the membrane in all areas of the crawlspace. In the case where discrete areas of the crawlspace cannot be covered by a membrane, the loose edge of the membrane will be trenched into the soil several inches. Additionally, an appropriate alternative will be selected among the following, for EPA approval:

- If the SMDS meets effectiveness criteria with no membrane cover over the discrete area, no alternative will be implemented.

- If the SMDS does not fully meet effectiveness criteria, soil gas dilution (inducing outdoor air ventilation in the crawlspace) and/or crawlspace air pressurization will be evaluated for the residence. A qualified ventilation technician will employ vacuum and airflow measurements as needed to evaluate system capacity requirements, energy penalties, and feasibility for the required volume of dilution air needed to achieve effectiveness criteria. Feasibility will also be dependent on the ability to prevent adverse effects including, but not limited to, unintentional soil gas transport to other portions of the building and backdraft of combustion appliances.

7.1.6 Potential for Field Modifications

This mitigation plan was prepared with the intent of accommodating unanticipated items that may come up during installation activities. However, Locus may make minor modifications to this mitigation plan, with EPA approval, based on issues encountered on site during installation.

8. Mitigation Termination Criteria

The vapor intrusion mitigation system will be operated until indoor air sample results meet the following criteria without operation of the mitigation system: results in the occupiable space are at or below the EPA long-term Screening Level of 0.48 µg/m^3 for TCE. EPA approval will be obtained prior to mitigation termination. The trigger to begin sampling for the evaluation of mitigation termination may be determined based on a combination of factors, such as, standpipe vent vapor sample results, regional soil gas screening levels, site-specific fate and transport modeling, TCE groundwater concentrations, and indoor air sampling.

9. Operations and Maintenance Plan

An Operations and Maintenance Plan is needed to ensure the installed vapor intrusion mitigation system meets performance expectations for as long as necessary. To accomplish that goal, this Operations and Maintenance Plan will include:

- Plans for indoor, outdoor, and vapor intrusion pathway air sampling; including sampling events during the winter heating season (refer to Section 10)
- Procedures for maintenance of vapor intrusion mitigation systems
- Frequency of inspections
- Required City building/safety permits or demonstration that required building/safety permit applications have been submitted with a placeholder Appendix for the final building/safety permit
- Occupant Information Sheets
- As-built drawings

9.1 Final Operations and Maintenance Plan

To ensure the proper operation of the vapor intrusion mitigation system, Locus and its subcontractors (if applicable) will inspect the system (described in Section 7) as follows:

- Quarterly during the first year of operation.
- Annually thereafter (upon EPA approval)

The inspector is licensed by the California State License Board and is certified and listed by the National Radon Safety Board for radon mitigation.

The inspections will be scheduled in coordination with the primary contact, and will include checking and repairing as necessary damage to the membrane and vent stack, seals on the membrane and vent stack, fan operation (including vacuum in vent stack, airflow, and fan

amperage), and electrical components. If water accumulation is observed on the membrane due to a leaking household pipeline, the property owner and/or manager will be notified. The inspector will follow the Operations and Maintenance Inspection Field Form as found in the appendix.

Each inspection is estimated to last three hours or less.

9.1.1 Operational Failure Analyses and Plans to Prevent Reoccurrence

The remote alarm system will communicate directly with Locus whenever the fan operation fails, that is, when the vacuum measurement falls below 0.25 inches of water (WC). Locus will respond, as soon as possible, to troubleshoot the system or complete any adjustments or repairs needed and will coordinate all visits with the primary contact. Note that having the fan off for several days for service or during power outages will have little impact on the overall indoor air quality as it takes time for soil vapors to accumulate underneath the structure at significant levels and then migrate to indoor air.

Any necessary adjustments or repairs identified through remote alarm-responses or routine inspections will be implemented with the intent to prevent reoccurrence. If reoccurrence is found not to have been prevented, necessary additional actions will be evaluated.

The placard posted near the remote alarm dialer will include instructions and contact information for the residents to call Locus' mitigation services (408-329-6654) for any questions or concerns.

9.1.2 Health and Safety

A detailed description of the health and safety measures for personnel operating and maintaining the vapor intrusion mitigation system is included in the site's Health and Safety Plan - Field Work Activities for Operation and Maintenance. Operation and maintenance activities will be conducted exclusively by Locus personnel and its contractors until such time

as mitigation criteria are met with EPA approval and the owner requests to keep, operate, and maintain the system. If the property owner or residents would like to request a copy of the Health and Safety Plan, please call Locus' mitigation services at 408-329-6654.

9.1.3 Quality Assurance / Quality Control

Vapor intrusion mitigation system operation and maintenance will comply with the Quality Assurance and Quality Control (QA/QC) guidelines specified in the Quality Assurance Project Plan (QAPP) for the Vapor Intrusion Work Plan, and all subsequent QAPP addendums. If the property owner or residents would like to request a copy of the QAPP, please call Locus' mitigation services at 408-329-6654.

9.1.4 Retention of Records

Field forms completed on the subject property to date are included in the appendices of this BSER. All records associated with operations and maintenance of the vapor intrusion mitigation system will be stored in accordance with the QAPP and made available when requested. If the property owner or residents would like to request a copy of the records associated with operations and maintenance of the vapor intrusion mitigation system subsequent to the date of this BSER, please call Locus' mitigation services at 408-329-6654.

9.1.5 Contact Information

In case of any questions or concerns regarding the vapor intrusion mitigation system, please call Locus Technologies at 408-329-6654 at any time to speak to a mitigation system representative. This is the same phone number to call in the event that the property owner or residents notice a fan failure. If the call is not answered directly, a voice message may be left. A Locus technician will respond to the voice message for system inspection and re-start, if needed.

Additional contact information for the area vapor intrusion mitigation project is provided in Section 1.3.

10. Building-Specific Sampling Plan Addenda

Building surveys, sampling, and data evaluation procedures will be conducted in accordance with the Vapor Intrusion Work Plan. The sampling plan for the subject property is more specifically defined herein. Section 10.1 identifies documentation associated with the sampling conducted to date. Sections 10.2 and 10.3 describe planned additional sampling.

10.1 Final Sampling Plan

This Final Sampling Plan was prepared to summarize documentation of the building surveys and sampling conducted to date. Refer to Section 4 for the chronology of sampling events. Refer to Section 6 for the vapor intrusion investigation findings. The associated building survey form/s and, if applicable, post-installation sampling forms are attached. The building layout is included in an attached figure. Historical sample locations are shown on the building layout, which were selected based on the findings described in the survey/s or, if mitigated, based on the post-installation sampling plan of earlier Draft BSERs. Sampling was completed consistent with winter sampling protocols of the Vapor Intrusion Work Plan, including targeting temperatures lower than 55 degrees Fahrenheit.

10.2 Initial Post-Installation Sampling Plan

After installation of the mitigation system described in Section 7, air samples will be collected from the crawlspace and living space using passive samplers at the following Location IDs:

- RES234-AMB-1: Unit #1, Living Room

- RES234-PATH-1: Unit #1, Under Kitchen Sink
- RES235-AMB-1: Unit #3, Living Room
- RES235-PATH-3: Crawlspace
- RES236-AMB-1: Unit #2, Living Room

~~RES234-AMB-1, RES234-PATH-1, RES235-AMB-1, RES235-PATH-3, and RES236-AMB-1.~~ Refer to Figure 1 for sampling locations. Sampling of indoor, crawlspace, and outdoor air will be conducted 1 to 2 weeks following installation, a month following initial sampling, and then during the first winter heating season and spring of operation, and then the second winter heating season of operation. If the vapor intrusion mitigation system modification is installed in summer 2022, indoor air sampling would proceed approximately as follows:

- Summer 2022, Twice. 1 to 2 weeks following installation, and 30 days following initial sampling.
- Winter 2022/2023. The first winter heating season of operation.
- Spring 2023. The first spring of operation.
- Winter 2023/2024. The second winter heating season of operation.

Where concentrations do not meet effectiveness criteria, the residence and vapor intrusion mitigation system will be surveyed to evaluate for potential chemical sources. The field forms for post-installation sampling and, if needed, building surveys will be included in the appendices.

If it is found necessary to improve the performance of the vapor intrusion mitigation system, the initial post-installation sampling schedule (through two consecutive winter heating seasons of operation) will start after improvements are implemented. If sampling conditions can be arranged such that interior ventilation is minimized in the occupiable space (for example, without active HVAC), effectiveness criteria will be evaluated under those conditions. The goal

of such improvements, if deemed necessary, will be to modify the components of the vapor intrusion mitigation system, detailed in Section 7, to meet effectiveness criteria.

Sampling events will be scheduled in coordination with the primary contact. Routine system inspections and maintenance will be aligned with when sampling will be conducted to the extent possible. In cases where routine system inspections are not aligned with sampling dates, the samplers will document in field notes the fan operation (on/off), the vacuum (inches water column), and any usual circumstances that should be considered for possible follow-up by operation and maintenance personnel.

10.3 Long-Term Sampling Plan

After the vapor intrusion mitigation system is found to be effective at mitigation of TCE vapor intrusion through the second winter heating season indoor air sampling event, long term sampling will be conducted to verify the effectiveness and performance of the installed vapor intrusion mitigation system. The following Location IDs will be sampled: RES234-AMB-1, RES234-PATH-1, RES235-AMB-1, RES235-PATH-3, and RES236-AMB-1. Long-term sampling will be performed as follows:

- Interim winter heating season sampling event prior to initiating once per 5 year sampling, if applicable; then,
- Every 5 years, to align with EPA Five-Year Reviews.

The maximum time between indoor air sampling events for vapor intrusion mitigation system performance monitoring will be five years. If site or building conditions change or if new and relevant information about the building is identified, the sampling frequency may be adjusted as necessary. For example, if building changes result in a greater potential for vapor intrusion, more frequent indoor air monitoring may be warranted.

11. References

Department of Toxic Substances Control (DTSC), October 2011, *Vapor Intrusion Mitigation Advisory*, Revision 1. https://semspub.epa.gov/work/09/1153970.pdf

EPA Office of Solid Waste and Emergency Response, June 2015, *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*, OSWER Publication 9200.2-154. OSWER, 2015: https://www.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor

Environmental Protection Agency Region 9, 2019, *CERCLA Docket No. 2019-05: Administrative Settlement Agreement and Order on Consent for Removal Site Evaluation And Removal Action,* 19 September. https://semspub.epa.gov/src/document/09/100018488

Locus Technologies, 2020, *Work Plan for Indoor Air / Vapor Intrusion Sampling and Analysis Removal, Triple Site Offsite Operable Unit, Sunnyvale, California*, 9 November. https://semspub.epa.gov/work/09/100024154.pdf